

Notice No.2

for the Code for Lifting Appliances in a Marine Environment July 2016

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Please note for the corrigenda items paragraphs, Tables and Figures are not shown in their entirety. Corrigenda items show amendments only.

Issue date: December 2016

Amendments to	Effective date
Chapter 2, Section 1	Corrigendum
Chapter 3, Sections 1 & 11	Corrigenda
Chapter 4, Sections 1, 5 & 7	1 January 2017
Chapter 4, Section 2	Corrigenda
Chapter 6, Sections 2 & 5	Corrigenda
Chapter 8, Sections 1 & 4	Corrigenda

Chapter 2 Derrick Systems

■ Section 1 General

1.5 Materials

1.5.2 Steel for masts, derrick posts and associated items included in the classification of the hull is to comply with the requirements of the *Rules for the Manufacture, Testing and Certification of Materials, July 2016*. The grade of steel is to comply with the requirements of *Table 2.1.1 Impact grade requirements for classed structures*, or Charpy impact test requirements are to comply with ~~Table 4.2.18 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel~~ *Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel* in Chapter 4 as appropriate.

Chapter 3 Launch and Recovery Appliances for Survival Craft and Rescue Boats

■ Section 1 General

1.6 Safety factors

1.6.1 The minimum safety factors (~~SF~~ **SF**) required with respect to the minimum ultimate tensile stress (σ_u) of the materials used in the construction of the primary structural members and the loose gear are given in *Table 3.1.1 Minimum safety factors*.

Table 3.1.1 Minimum safety factors

Item	SF ~~SF~~ required on σ_u	
	Direct stress	Sheer stress
Structural components	4,5	7,8
Loose gear	6,0	10,3
Release hooks	6,0	10,3

1.6.2 For steel in which $\sigma_y/\sigma_u \leq 0,7$, the allowable compressive stress, σ_a , in primary structural members is given by the following expression:

$$\sigma_c = \frac{\sigma_{cr}}{SF \times \frac{\sigma_y}{\sigma_u}}$$

where

σ_{cr} = critical compressive stress, ~~see Table 4.2.10 Values of σ_{cr} for steel for varying σ_y~~ in Chapter 4

1.11 Materials

1.11.2 The selected steel grade is to provide adequate protection against brittle fracture, taking into account the material tensile stress, component thickness and the ship's intended service environment, and in general, the materials are to comply with the Charpy test requirements given in ~~Table 4.2.18 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel~~ *Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel* in Chapter 4.

Chapter 4

Cranes and Submersible Lifting Appliances

■ Section 1 Introduction

1.1 General

1.1.5 The design of the crane shall be carried out following the principle that in general the supporting structure of the crane cabin is not the first to fail. Furthermore, the crane shall enter a less critical state (taking into account the safety of persons, equipment and environment) after the first element has failed. This behaviour of the crane is usually achieved by carrying out a failure mode analysis (taking into account all operational conditions) which is to evaluate the failure load of all critical load carrying elements (e.g. pedestal, slewing ring, crane house, jib, reeving systems, hook, etc.) and the failure sequence.

1.1.6 The operation of the crane is in general to be smooth, controlled and carried out by trained personnel.

■ Section 2 Shipboard cranes

2.7 Slewing forces

2.7.3 The slewing acceleration is to be applied to dead weight and the SWL of the crane. The slewing acceleration is to be taken as 100 per cent of its nominal value up to 40 t SWL and can then gradually be reduced to 50 per cent of its nominal value until 160 t SWL. Beyond 160 t SWL, the slewing acceleration shall remain constant at 50 per cent of its nominal value. The SWL to determine the slewing acceleration is to be taken as the maximum SWL on the load versus radius charts. The graphical representation of the above can be found in *Figure 4.2.2 Slewing acceleration*.

2.17 Allowable stress – Elastic failure

2.17.7 The allowable bearing stress for rotatable and fitted pin connections are to be taken as per the allowable bearing stresses for fitted bolts given in ~~Table 4.2.15 Allowable stresses for fitted bolts~~ *Table 4.2.14 Allowable stresses for fitted bolts*. The allowable bearing stress for rotatable pin connections with dynamics or loose fit will be specially considered.

2.18 Allowable stress – Compression, torsional and bending members

2.18.2 For members subjected to simple compression, the critical compression stress is given by the Perry-Robertson formulae as follows:

$$\sigma_{cr} = \frac{\sigma_y + (1 + \eta) \sigma_e}{2} - \sqrt{\left(\frac{\sigma_y + (1 + \eta) \sigma_e}{2} \right)^2 - (\sigma_y \sigma_e)}$$

~~Values of critical compression stress are given in Table 4.2.10 Values of σ_{cr} for steel for varying σ_y .~~ Alternative methods to calculate the simple critical compression stress as per recognised National or International Standards or analysis taking into account second and higher order effects may be considered. In the case where the stability is calculated by means of second or higher order analysis, suitable imperfections are to be taken into account and the loads are to be multiplied by the inverse of the stress factor $1/F$ where the actual stress results are then to be compared with the yield stress of the component.

Table 4.2.10 Values of σ_{cr} for steel for varying σ_y

Yield stress, in N/mm ²		240				260				360			
Slenderness ratio, s	Robertson's constant, a	2,0	3,5	5,5	8,0	2,0	3,5	5,5	8,0	2,0	3,5	5,5	8,0
20		239	239	238	237	259	258	257	255	356	353	350	345
30		234	230	224	218	253	248	242	234	348	339	328	316
40		228	220	210	199	246	237	226	214	337	322	305	286
50		221	209	195	181	238	225	210	194	323	301	278	256
60		212	196	180	163	228	210	192	174	302	275	249	225
70		200	182	163	146	214	193	174	156	272	245	219	196
80		185	165	147	131	196	175	155	138	237	213	190	170
90		167	148	131	116	175	156	138	122	202	182	164	147
100		149	132	117	103	154	137	122	108	171	156	141	127
110		131	117	103	92	134	121	107	96	146	134	122	111
120		115	103	92	82	117	106	95	85	125	116	106	97
130		101	91	82	73	102	93	84	76	108	101	93	85
140		89	81	73	66	90	83	75	68	94	89	82	76
150		78	72	66	59	79	74	67	61	83	78	73	68
160		70	65	59	53	71	66	60	55	73	69	65	61
180		56	53	48	44	57	53	49	45	59	56	53	49
190		51	48	44	40	51	48	45	41	53	51	48	45
200		46	44	40	37	47	44	41	38	48	46	44	41
210		42	40	37	34	42	40	38	35	43	42	40	38
220		39	37	34	32	39	37	35	32	40	38	37	35
230		35	34	32	29	36	34	32	30	36	35	34	32
240		33	31	29	27	33	31	30	28	34	32	31	30

2.20 Slenderness ratio

2.20.1 The slenderness ratio of compression members is given by the general expression, i.e. $s = \frac{KL}{r}$. For members which have constant area and uniformly varying second moment of area and hence radius of gyration, such as crane jibs, an effective radius of gyration is to be considered. The effective radius of gyration is given by:

$$r_e = \left(\frac{I_e}{A} \right)^{\frac{1}{2}}$$

where

I_2 = maximum second moment of area of member in the plane concerned and m is obtained from ~~Table 4.2.11 m factor for various values of I_1/I_2~~ **Table 4.2.10 m factor for various values of I_1/I_2** to **Table 4.2.12 m factor for various values of I_1/I_2 and a/L** , as appropriate.

Table 4.2.11 4.2.10 m factor for various values of I_1/I_2

Table 4.2.12 4.2.11 m factor for various values of I_1/I_2 and a/L

Table 4.2.13 4.2.12 m factor for various values of I_1/I_2 and a/L

2.23 Allowable stresses – Joints and connections

2.23.2 For fillet welds and partial penetration welds, the allowable stresses are reduced. Values of these reduced stresses are given in ~~Table 4.2.14 Allowable stresses in welds~~ **Table 4.2.13 Allowable stresses in welds**. Where F is the stress factor, see **Table 4.2.6 Stress factor, F** . **Figure 4.2.12 Stresses in welds** shows the stresses in a typical fillet weld. The actual stress in the fillet welds is to be less than or equal to the allowable stresses and is to be evaluated as follows:

Table 4.2.14 4.2.13 Allowable stresses in welds

2.23.6 For joints using precision bolts, defined as turned or cold finished bolts fitted into drilled or reamed holes whose diameter is not greater than the bolt diameter by more than 0,4 mm, the allowable stress due to the externally applied load is given in ~~Table 4.2.15 Allowable stresses for fitted bolts~~ **Table 4.2.14 Allowable stresses for fitted bolts**.

Table 4.2.15 4.2.14 Allowable stresses for fitted bolts

2.23.7 The allowable stresses for non-fitted bolts are to be taken as per ~~Table 4.2.16 Allowable stresses for non-fitted bolts~~ **Table 4.2.15 Allowable stresses for non-fitted bolts**.

Table 4.2.16 4.2.15 Allowable stresses for non-fitted bolts

2.24 Slewing ring and slewing ring bolting

2.24.6 The allowable tensile stress for bolts to ISO 898-1 grade associated with the external loading of *Ch 4, 2.24 Slewing ring and slewing ring bolting 2.24.5*, and pretensioned in accordance with *Ch 4, 2.24 Slewing ring and slewing ring bolting 2.24.5*, are given in ~~Table 4.2.17 Allowable stress in ISO 898-1 bolts~~ *Table 4.2.16 Allowable stress in ISO 898-1 bolts*. Alternative methods as described in *Ch 4, 2.23 Allowable stress – Joints and connections 2.23.5* may be considered.

~~Table 4.2.17~~ **4.2.16 Allowable stress in ISO 898-1 bolts**

2.25 Materials

2.25.2 The selected steel grade is to provide adequate assurance against brittle fracture, taking into account the material tensile strength and thickness and the environment in which the crane is designed to operate, see *Ch 11 Materials and Fabrication*, and is in general to comply with the Charpy V-notch impact test requirements given in ~~Table 4.2.18 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel~~ *Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel*.

~~Table 4.2.18~~ **4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel**

2.25.4 Special consideration may be given to proposals to use materials which do not meet the requirements of ~~Table 4.2.18 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure~~ *Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel* where it can be shown that satisfactory service experience has resulted from the particular materials and construction.

~~Table 4.2.19~~ **4.2.18 Charpy V-notch test impact energy requirements for classed and certified lifting appliances**

~~Table 4.2.20~~ **4.2.19 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels**

Note 3. For cast and forged components, the minimum specified average energy for Charpy V-notch tests is to be at least 27J. For rolled products the Charpy V-notch impact energy requirements are to comply with ~~Table 4.2.19 Charpy V-notch test impact energy requirements for classed and certified lifting appliances~~ *Table 4.2.18 Charpy V-notch test impact energy requirements for classed and certified lifting appliances*.

■ Section 5 Pedestals and foundation

5.3 Allowable stresses

5.3.4 As an alternative to the stress factors F_p as defined in *Table 4.5.1 Stress factor, F_p* the stress factors as defined in *Table 4.5.2 Alternative stress factor, F_p* can be applied, provided all of the following conditions are fulfilled:

- A fatigue analysis according to a recognised national or international standard (e.g. F.E.M. 1.001) has ~~been~~ satisfactorily been carried out taking into account operational loads;
- Overload protection systems are installed;
- ~~Means are provided to protect the driver's cabin.~~
- Beyond a SWL of 160t only engineered lifts are to be carried out;
- The structural integration of the crane pedestal into the supporting ship structure is to be verified where required, taking into account the global hull girder stresses for the corresponding loading condition (still water loads and wave loading if applicable) and superimposing the stresses resulting from the crane operation.

The graphical representation of *Table 4.5.2 Alternative stress factor, F_p* has been provided in *Figure 4.5.1 Stress factor, F_p* .

5.4 Materials

5.4.2 The grade of steel for pedestals of ship-mounted cranes is to be selected in accordance with LR steel grades equivalent to ~~Table 4.2.18 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel~~ *Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel*, ~~Table 4.2.19 Charpy V-notch test impact energy requirements for classed and certified lifting appliances~~ *Table 4.2.18 Charpy V-notch test impact energy requirements for classed and certified lifting appliances* and ~~Table 4.2.20 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels~~ *Table 4.2.19 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels* (as applicable) with the operating temperature chosen as being the lesser of either that from an assigned winterisation notation, or the defined minimum design temperature for the crane in operation.

■ Section 7

Launch and recovery appliances for manned tender boats

7.1 General

7.1.1 This Section covers the design requirements for the launch and recovery appliances for manned tender boats.

7.1.2 In general, the launching and recovery of tender boats with persons aboard is considered a higher risk activity than the launching and recovering of unmanned tender boats.

7.1.3 The requirements of *Ch 4, 2 Shipboard cranes* are also to be complied with unless specified differently within this Section.

7.1.4 The requirements of *Ch 4, 6 Handling of personnel* and *Ch 9, 4 Man-riding and personnel lifting machinery* are also to be complied with unless specified differently within this Section.

7.1.5 The requirements of this Section are considered appropriate for launch and recovery operations carried out under the following conditions:

- (a) the mothership supporting the appliance shall be stationary;
- (b) operations are conducted in harbour or sheltered water conditions;
- (c) operating temperature is above -50°C and below +45°C;
- (d) minimum design temperatures is above -40°C (see *Ch 4, 2.25 Materials 2.25.3*);
- (e) wind speeds do not exceed 4 m/s;
- (f) heel and trim of the mothership do not exceed 5° and 2° respectively;
- (g) significant wave height does not exceed 1,0 m;
- (h) daylight visibility or equivalent;
- (i) Operator of the appliance has continuous direct means of communication with the personnel to be lifted or direct line of sight with the personnel to be lifted;
- (j) crew embarks at the lowest possible location above the water line; and
- (k) the number of persons aboard the tender boat during hoisting and lowering are limited to those essential crew members required for safe operation and preparation of the tender boat for launch and recovery.

7.1.6 The scope of this Section does not include:

- (a) lifting, handling and erection of the appliance or its components;
- (b) transport of appliances and/or their components;
- (c) collision loads, e.g. collision of the tender boat with the hull of the mothership or with an object in the water, etc.;
- (d) assembling or disassembling of the appliance and/or its components;
- (e) scrapping or disabling of the appliance and/or its components;
- (f) appliances for life-saving; and
- (g) appliances installed on naval vessels.

7.1.7 The designer shall evaluate any additional arrangement requirements based on the operational profile of the appliance. The operational profile shall be decided in collaboration with the Owner/Operator, such that it is fully understood by all parties. The operational profile and any additional requirements are to be communicated to LR for consideration.

7.1.8 The responsible National Authorities and Flag States may have additional requirements which need to be adhered to. In case of any conflict arising between these requirements and those of the National Authorities and Flag States, the requirements of the National Authorities and Flag States take precedence.

7.2 Terms and definitions

7.2.1 Machinery

is defined as mechanical, electrotechnical or hydraulic systems (and their combinations) used to move the appliance, its components and/or its load.

7.2.2 Mothership

is defined as the ship which carries the tender boat and its launch and recovery appliance.

7.2.3 Safe Working Load (SWL)

The general definition of the SWL is included in *Ch 1, 2.1 Safe Working load (SWL) of a lifting appliance*. Within the context of this Section, the maximum static load for appliances used for the launch and/or recovery of manned tender boats is defined as the fully laden weight of the tender boat, including the crew required to handle the tender boat.

7.2.4 Significant wave height ($H_{1/3}$)

is defined as the average of the one third highest waves (measured from trough to crest) in a short term wave measurement record.

7.2.5 Tender boat

is defined as a small craft which is carried on the mothership for the purposes of transferring crew, passengers or other personnel.

7.3 Loads and design factors

7.3.1 A risk coefficient, γ_n , shall be applied to the dead load and the SWL of the appliance to account for the increased risk associated with personnel handling. The risk coefficient shall be taken as follows:

- (a) for $h \leq 3$ m: $\gamma_n = 1,05$;
- (b) for $h \geq 10$ m: $\gamma_n = 1,5$;
- (c) for $3 \text{ m} < h < 10 \text{ m}$: $\gamma_n = \frac{9}{140}h + \frac{6}{7}$

where

h = lifting height as measured between the waterline of the mothership and the bottom of the keel of the tender boat (in metres).

Proposals for the application of alternative risk factors will be specially considered.

7.3.2 In case of the absence of actual dynamic factors, the hoisting factor shall be taken as follows:

- (a) for $H_{1/3} \leq 0,6$ m: $F_h = 1,46$;
- (b) for $H_{1/3} \leq 1,0$ m: $F_h = 1,60$.

Values for hoisting factors between $H_{1/3}$ of 0,6 m and 1,0 m may be linearly interpolated.

The application of lower hoisting factors will be specially considered if supported by a technical justification. $H_{1/3}$ is generally limited to 1,0 m. The hoisting factor for $H_{1/3}$ beyond 1,0 m will be specially considered. The application of higher dynamic factors, other than those given above, shall be considered if required by design implications and/or environmental circumstances.

7.3.3 The duty factor shall be determined in accordance with the requirements of *Ch 4, 2.3 Duty factor*.

7.3.4 The heel and trim angles of the mothership shall be taken as 5° and 2° respectively. The heel and trim angles shall be applied to the dead weight of the appliance and the SWL. The heel and trim angles for values of $H_{1/3}$ above 1,0 m will be specially considered.

7.3.5 In cases where $H_{1/3} \geq 1,0$ m, the mothership accelerations are to be taken into consideration.

7.3.6 The offlead and sidelead angles (which are to be applied to the SWL) are both taken to be a minimum of 3° unless environmental or other conditions require higher angles to be applied. The offlead and sidelead angles are to be applied in addition to the heel and trim angles of the mothership. Consideration will be given to lower angles if it can be demonstrated that such angles can be effectively restricted. The offlead and sidelead angles for $H_{1/3}$ above 1,0 m will be specially considered.

7.3.7 If necessary, bow-lines (painters) and bowsing-lines should be used in order to stabilise the tender boat and in order to avoid swinging of the tender boat.

7.3.8 Effects of wind on tender boats shall be considered. The design wind speeds and force coefficients shall be determined in accordance with the requirements of *Ch 4, 2.12 Wind loading*.

7.4 Machinery

7.4.1 The appliance's hoisting and luffing winches (where fitted) are to be approved by LR for personnel handling and details of the winches are to be submitted for appraisal.

7.4.2 The appliance's hoisting and luffing winches (where fitted) are to be fitted with primary automatic type brakes. These are to be of the interlocking type, where a failure in the brake system, including loss of power, will cause the brake to be applied automatically.

7.4.3 The hoisting and luffing winches (where fitted) are to be equipped with mechanically and operationally independent secondary braking systems. The control system for these secondary brakes shall be independent of the primary brake. Both primary and secondary brakes are to be automatically applied in case of the emergency stop being activated or in the event of a failure in the brake system.

7.4.4 The secondary brake system shall operate directly on the winch drum or drum shaft. Other proposals (e.g. a fully independent load path) will be specially considered.

7.4.5 Each winch brake shall be fitted with an override and means are to be provided to enable the recovery of the tender boat to safety from any position in the event of a failure of the brake system or other emergency situations. The override shall be protected against inadvertent activation. The emergency recovery concept, shall be submitted for appraisal.

7.4.6 The length of the steel wire rope shall be such that a minimum of three wraps remains on the winch drum at all times. End terminations (for the drum and elsewhere in the reeving system) shall adequately secure the rope to the winch drum in accordance with the rope manufacturer's recommendations. Reference is made to the requirements of *Ch 8, 6.4 Splicing and terminal connections*.

7.4.7 The minimum number of wraps necessary for fibre ropes installed on winch drums will be specially considered. End terminations (for the drum and elsewhere in the reeving system) shall adequately secure the fibre rope to the winch drum in accordance with the rope manufacturer's recommendations. Reference is made to the requirements of *Ch 8, 7.3 Splicing and terminal connections*.

7.4.8 Winch drum connections and end terminations for wire and fibre ropes shall be of an approved type.

7.4.9 Where hydraulic cylinders are used for luffing, folding or telescoping, they are to be fitted with pilot-operated non-return valves at both inlet and outlet manifolds to ensure that the cylinders remain in position in the event of a hydraulic failure. The required pilot-operated non-return valves are to be fitted directly to the cylinder ports. Other valves, which provide a similar and sufficient level of safety and functionality to pilot-operated non-return valves, will be specially considered.

7.4.10 The accumulated number of operating load cycles shall be recorded in order to ensure that the design lifetime of any part of the appliance (e.g. rope, winch gear, structure, etc.) is not exceeded during the service life of the appliance. This information is to be made available to the attending Surveyor.

7.5 Ropes and loose gear

7.5.1 The wire rope safety factor shall be determined in accordance with the requirements of *Ch 4, 3.9 Rope safety factors*. The derived rope safety factor shall be multiplied by the risk coefficient as defined in *Ch 4, 7.3 Loads and design factors 7.3.1*. Rope safety factors for significant wave heights beyond 1,0 m will be specially considered.

7.5.2 The man-made fibre rope safety factor shall be determined in accordance with the requirements of *Ch 4, 7.5 Ropes and loose gear 7.5.1* and shall be multiplied by a factor of 1,25. The instructions for use issued by the fibre rope manufacturer and any requirements, pre-cautions and limitations stated therein are to be complied with. These instructions are to be made available to the competent person and attending Surveyor.

7.5.3 The maximum number of guaranteed load cycles for the fibre rope (as stated by the fibre rope manufacturer) shall be divided by the risk coefficient as defined in *Ch 4, 7.3 Loads and design factors 7.3.1*. The actual load cycles the reeving system is subjected to shall be recorded and compared with the number of guaranteed load cycles for the fibre rope divided by the risk coefficient.

7.5.4 Loose gear items (including hook and hook block) are to have a safety factor of $\gamma_n \times 5$ against the ultimate tensile strength of the materials used. The minimum safety factor shall be 6.

7.5.5 Hooks are to be designed for the purpose of lifting manned tender boats. The manufacturer of the hooks shall specify that the hooks are suitable for the purposes of launching and recovery of manned tender boats.

7.5.6 Hooks shall incorporate a means to prevent inadvertent opening or other accidental loss of the load (i.e. the manned tender boat). The arrangement shall be submitted for consideration and the effectiveness shall be demonstrated to the attending Surveyor.

7.5.7 Hooks are to be forged. Special consideration will be given to alternative proposals.

7.5.8 Where the appliance is equipped with more than one reeving system (e.g. two beams, each with a separate reeving system), details of the arrangements to prevent unequal lowering or hoisting of the tender boat are to be submitted for consideration and the effectiveness shall be demonstrated to the attending Surveyor.

7.6 Instructions for use

7.6.1 Instructions for use and the maintenance manual are required to be provided. The instructions for use shall cover all operational and emergency procedures, including any conditions, pre-cautions and limitations for manned tender boat launching and recovery operations.

7.7 Continuous improvement

7.7.1 The appliance manufacturer shall have a documented quality assurance system with a 'continuous improvement process' in place. The continuous improvement process shall take account of the findings from operational experience and feedback with a view to:

- (a) further improvements in the design, operating procedures and instructions for use;
- (b) further improvements to the maintenance of existing appliances in service;
- (c) an adjustment of inspection intervals; and
- (d) an adjustment of scheduled replacements of parts.

7.7.2 The operational experience and feedback may be provided through the manufacturer's own experiences and/or provided by the appliance's Owners and/or Operators, maintainers, inspectors/Surveyors and competent persons.

7.8 Risk assessment

7.8.1 In case it is intended to deviate from the requirements as stipulated in this Section, it is required to prepare a risk-based justification in line with LR's *ShipRight, Design and Construction, Additional Design Procedures, Risk Based Designs (RBD)*. The RBD process requires the manufacturer to carry out a suitable and sufficient risk assessment based on own information and experience and information received from the Owners and/or Operators.

7.8.2 The manufacturer shall prepare a Safety Statement in line with the RBD process which, as a minimum, shall describe:

- (a) the boundary of the system intended to be assessed;
- (b) the risk management process intended to be followed;
- (c) the risk assessment tools intended to be used; and
- (d) the acceptance criteria that will be used to determine if a risk is tolerable.

7.8.3 It shall be ensured that the boundaries of the risk assessment are set wide enough to suitably and sufficiently assess the system which is defined as the appliance and its components embedded in its environmental situation (e.g. mothership, environmental conditions such as wind/ $H_{1/3}$ /heel/trim, etc.). The system is required to be assessed in its entirety, and the boundaries are to be shifted until there are no parts or components having any influence on the appliances and vice versa.

7.8.4 It is the responsibility of the manufacturer to ensure the intended process and acceptance criteria meet the requirements of LR as given in the RBD. It is further required that the intended process and acceptance criteria are acceptable to the National Authority who may have requirements in addition to the methodology given in this Section and/or the RBD process.

7.8.5 The risk assessment shall clearly set out the boundary of the system to be assessed. As a minimum, it should consider the safety of the system during normal operation, during emergency conditions and while the system is out-of-service. As a minimum, the assessment is required to:

- (a) demonstrate the system meets the performance requirements;
- (b) demonstrate the appliance meets the performance requirements;
- (c) demonstrate the components of the appliance meet the performance requirements;
- (d) take into account the interfaces between the appliance and the mothership;
- (e) identify the potential hazards to the safety and integrity of the system and appliance and specifically quantify and rank these risks in terms of their consequence and frequency;
- (f) identify those risks that are unacceptable in relation to the defined performance requirements;
- (g) identify what prevention and/or mitigation actions are to be taken in order to reduce the risks that are unacceptable to a level tolerable to LR and the National Authority;
- (h) identify parts and/or components of the appliance and the system that are critical in relation to the management of the identified risks and hazards; and
- (i) clearly identify the hazards that may threaten the safety or integrity of the system and/or the appliance, or otherwise endanger the crew and other persons.

7.8.6 Suitable protective measures and safety features shall be introduced as a consequence of the risk assessment.

7.8.7 The instructions for use of the appliance shall be compiled based upon the findings of the risk assessment.

7.8.8 The manufacturer is responsible for communicating the output of the assessment to the Owner and/or Operator.

7.8.9 The manufacturer is responsible for implementing any mitigation measures relevant to the design of the appliance. The Owner and/or Operator is responsible for implementing any mitigation measures relevant to the operation of the appliance. One of the outcomes of the risk assessment shall be who is responsible for which mitigation measures and the definition of the interfaces between the manufacturer and the Owner and/or Operator.

7.8.10 The risk assessment should be carried out in accordance with relevant and recognised National and International Standards. In particular, the following standards shall be taken into consideration:

- (a) ISO 31000 *Risk management*;
- (b) ISO 31010 *Risk management – Risk assessment techniques*;
- (c) ISO Guide 73 *Risk management – Vocabulary*; and
- (d) ISO 12100 *Safety of machinery — General principles for design — Risk assessment and risk reduction*.

7.8.11 Whilst the manufacturer may use specialised support to produce the risk assessment, they remain accountable for the production of the risk assessment and demonstrating that deviating from the prescribed requirements does not lead to an increase in risk.

7.8.12 It is, in general, recommended to carry out a risk assessment for the appliance under due consideration of the conditions of the system (e.g. mothership, environmental) the appliance will be installed in and the interfaces between the appliance and the mothership. The risk assessment shall be carried out taking into account the methodology as given in 7.8 *Risk assessment*.

7.9 Testing and survey requirements

7.9.1 The testing of the appliance is to be carried out in accordance with the requirements of *Ch 12 Testing, Marking and Surveys* as applicable.

7.9.2 Before any launching or recovery operation commences, an inspection/examination of the appliance and associated gear/equipment/components is required prior to each individual manned use. The tender boat shall first be lowered and hoisted for a few meters without persons on board in order to ascertain that the arrangement operates safely and correctly. The inspection/examination shall be documented and shall be made available to the attending Surveyor.

7.9.3 The static test load for the appliance shall be taken as follows:

SWL ≤ 20t: 1,50 x SWL

20t < SWL ≤ 50t: SWL + 10t

SWL > 50t: 1,20 x SWL

The appliance is further dynamically tested to 1,1 x SWL.

7.9.4 Each of the primary and secondary brakes shall be statically tested to at least 1,5 times the SWL and dynamically tested to at least 1,1 times the SWL.

7.9.5 The appliance and its associated equipment are to be thoroughly examined at least every six months by a competent person. The thorough examination shall be documented and shall be made available to the attending Surveyor.

Chapter 6 Ro-Ro Access Equipment

■ Section 2 Loading and design criteria

2.13 Materials

2.13.3 Where the Ro-Ro equipment is subject to certification only, the selected steel grade is to provide adequate assurance against brittle fracture taking into account the material tensile strength and thickness and the environment in which the Ro-Ro equipment is designed to operate and, in general, is to comply with the Charpy test requirements given in ~~Table 4.2.18 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel~~ Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel in Chapter 4.

■ Section 5 Internal moveable vehicle ramps

5.4 Ramp lifted with passenger

5.4.1 In cases where the ramp is lifting with a passenger, the ~~SF~~ SF for wire rope and items of loose gear must not be less than 6.

Chapter 8

Fittings, Loose Gear and Ropes

■ Section 1 General

1.2 Materials and construction

1.2.2 Steel for bearing brackets and other items welded to the ship's structure (including to the masts, derrick posts and crane pedestals) is, generally, to comply with the requirements of the Rules for the Manufacture, Testing and Certification of Materials (hereinafter referred to as the Rules for Materials). The grade of steel is to be selected in accordance with LR steel grades equivalent to ~~Table 4.2.18 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel and~~ Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel and ~~Table 4.2.20 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels~~ Table 4.2.19 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels in Chapter 4, with the operating temperature chosen as being the lesser of either that from an assigned winterisation notation or the defined minimum design temperature for the crane in operation.

■ Section 4 Spreaders and lifting beams

4.1 General

4.1.2 Steel used in the construction of the beam is to be of weldable quality in accordance with Ch 8, 1.2 Materials and construction. The grade of steel is to be selected in accordance with ~~Table 4.2.18 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel~~ Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel, ~~Table 4.2.19 Charpy V-notch test impact energy requirements for classed and certified lifting appliances~~ Table 4.2.18 Charpy V-notch test impact energy requirements for classed and certified lifting appliances and ~~Table 4.2.20 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels~~ Table 4.2.19 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels in Chapter 4, based on the minimum design temperature for the location where the beam will be used.

4.2 Loading and allowable stress

4.2.3 The wire ropes forming the slings for beams and spreaders are to have a minimum safety factor, ~~SF~~ **SF**, derived from Ch 4, 2.26 Rope safety factors and sheave ratio 2.26.1 or Ch 4, 3.9 Rope safety factors 3.9.1 (as applicable). The minimum breaking load of the sling is given by:

$$\text{MBL} = \text{SF } \text{SF} \times L$$

MBL = minimum breaking load of rope

L = maximum static tension in the sling set.

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